

**OCCUPATIONAL SAFETY
AND HEALTH STANDARDS BOARD**

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Attachment No. 2

INITIAL STATEMENT OF REASONS**CALIFORNIA CODE OF REGULATIONS**

**TITLE 8: Chapter 4, Subchapter 7, Article 107, Section 5154.1
of the General Industry Safety Orders**

Ventilation Requirements for Laboratory-Type Hood Operations**SUMMARY**

Existing Section 5154.1, Ventilation Requirements for Laboratory-Type Hood Operations, provides minimum requirements for the protection of employees when laboratory-type hoods are used to prevent harmful exposure. Section 5154.1 specifies minimum ventilation and performance requirements, limitations on the use of laboratory type hoods, and several specific requirements related to the design and use of laboratory-type hoods. The specific requirements relate to concentrations of flammable materials in the hood and duct, hazards associated with the exhaust stack, blowers, biological contaminants, use with perchloric acid, placarding of deficient hoods, devices used to indicate airflow, and a requirement that the inward flow into the hood be demonstrated.

The objectives of proposed revisions to Section 5154.1 are to improve the performance of laboratory-type fume hoods when they are used to control harmful exposure to toxic materials or the potential risk of fire and explosion. Labor Code Section 144.6 requires the Occupational Safety and Health Standards Board (Board) to adopt standards for toxic materials that assure that no employee suffers material impairment or loss of functional capacity from exposure to such materials. Laboratory-type hoods are used to control the extent to which employees are exposed to toxic materials and the risk of fire and explosion. Section 5154.1 is intended to place requirements on the use and performance of laboratory-type hoods that makes the hoods effective as devices to control these hazards. Other changes are proposed that will clarify existing requirements, but not substantively change them. The proposed changes were developed by the Division of Occupational Safety and Health (Division) with the assistance of an advisory committee. The advisory committee met six times between May 2, 2000 and August 8, 2001. The changes described below were recommended by that committee as consensus recommendations. A rationale for the changes described below was also provided by this committee.

Changes are proposed to the current definitions of the terms "hazardous substance" and "laboratory-type hood" in subsection (b). The change to the term "hazardous substance" is intended to emphasize that hazardous substances are those likely to cause injury or illness in the form and manner used, and not substantively alter the meaning of the term. The term "laboratory-

type hood” is changed to indicate that laboratory-type hoods are used to contain hazardous substances as compared with the current description as a device in which they are used. This change is intended to make the definition of “laboratory-type hood” consistent with the change to the term “hazardous substance.”

Subsection (c), Ventilation Rates, is changed by adding an option to operate the laboratory-type hood at a reduced average face velocity of 60 fpm if the hood is not being accessed by an operator and other specified conditions are met. The effect of this change will be to provide a reduced ventilation rate while not compromising the ability of the laboratory-type hood to contain the hazardous substances in the hood. A non-substantive change is also proposed to change the current velocity units from “linear feet per minute” to “feet per minute”. This change will make the velocity unit consistent with the units used in other ventilation standards.

The requirement in subsection (e)(2) to install sash closure restrictions is changed to permit hoods to operate without a permanent sash stop, provided other openings into the hood such as the space under an airfoil are sufficient to ventilate the hood for explosion control. The effect of this change will be to eliminate the need for installing unnecessary sash stops in these cases.

The requirements in subsection (e)(3) are changed by replacing the current requirement for a qualitative airflow indicator to a requirement for a quantitative indicator. The requirement for inward airflow demonstration is changed to reference a specific procedure for airflow demonstration and velocity measurement and that this demonstration is required to be conducted on an annual basis, as well at installation, repairs or renovation, and the addition of large equipment into the hood. The change includes an exception permitting biannual airflow demonstration and velocity measurement if a calibration and maintenance program is in place for the quantitative indicator. The effect of this change will be to provide the hood user with a means of detecting changes in the airflow into the hood which cannot be detected with qualitative indicators, and which can cause significant reduction in the ability of the hood to control harmful exposure. The effect of the requirement for a specific procedure to demonstrate inward airflow on an annual basis will be to improve the reliability of the airflow demonstration to detect hoods with inadequate capture and containment characteristics initially and over time.

The requirement at subsection (e)(7) specifying construction materials is changed to include references to more recent polymer materials which are suitable for construction of laboratory-hoods that are used in perchloric acid evaporation processes. This change is not intended to substantively alter the current requirement. The effect of this change is to reduce uncertainty when these more recent materials are used.

The proposal adds a new subsection regarding hood operator qualifications. The subsection requires that employers take steps to ensure that employees understand the functional characteristics of the hood and are able to use the hood safely. The subsection requires that the employees be familiar with the performance testing requirements for the hood and can determine when the hood was last tested. The effect of this change will be to reduce the risk that employees use laboratory-type hoods in an unsafe manner, the employee is unaware that required

performance tests have not been performed, or that the hood is currently operating in an unsafe manner.

SPECIFIC PURPOSE AND FACTUAL BASIS OF PROPOSED ACTION

The purpose of changes to the definitions for Hazardous Substance and Laboratory-Type Hood in subsection (b) is to further clarify that the hazard associated with the use of a substance depends on the physical form of the substance and the manner in which it is used. The advisory committee cited the example of a fine lead powder possibly needing a laboratory hood, whereas a large solid piece of lead would likely not. This change is intended to clarify the meaning of these two terms while not substantively changing them.

The purpose of the change to subsection (c) that allows the face velocity of an unoccupied laboratory-type hood to be reduced to 60 fpm is to permit hoods meeting the stated conditions to operate at lower flow rates while providing protection equivalent or superior to that provided by a face velocity of 100 fpm with an operator present. In 1999 a paper was published in the ASHRAE Transactions, which examined the containment characteristics of three hoods with different designs using tracer gas tests specified in ANSI/ASHRAE 110-1995 (ref.1, Greenley). This experiment measured tracer gas leakage with a mannequin to simulate an operator at 100 fpm, and tracer gas leakage without a mannequin as an unoccupied hood at 60 fpm. The paper concludes that the tests performed indicate that containment is as good or better at an unoccupied hood at 60 fpm than it is at an occupied hood (with a mannequin) at 100 fpm. One of the conditions required as a prerequisite for operation at reduced velocity is that the hood be tested at the reduced flow according to the ANSI/ASHRAE 110-1995 tracer gas test procedure and achieve a hood rating of 4 or 0.1 or less. The advisory committee recommended that this test be performed to assure that the hood containment at reduced velocity is adequate to protect nearby workers. A laboratory-type hood that operates at reduced face velocities is more susceptible to room air currents than when it is operating at a higher face velocity with equivalent room air currents. These room air currents can be present with or without an operator and can contribute to contaminant escape from the hood. A paper was published in ASHRAE Transactions in 1977 (ref. 2, Caplan) that demonstrates the effect of room air currents with and without an operator (as simulated by a mannequin). Figure 4 of this paper, "Effect of room air challenge without dummy", demonstrates that the adverse effect of room air challenges on containment at low face velocity is much greater than equivalent room air challenges at higher hood face velocities. A hood with a given level of room air challenge and satisfactory performance at 100 fpm can deteriorate and allow contaminant escape when the flow is reduced to a 60 fpm level and when the room air challenge remains the same. The requirement that records of the tracer gas test results and the "as used" test configuration be maintained for the duration of use at reduced flow and thereafter for five years is included to permit verification that the required tests have been performed.

Subsection (e)(2) is changed to eliminate the need for permanent sash stops when other features of the hood can provide sufficient ventilation for explosion control. The purpose of this change is to provide the employer an alternative to the installation of permanent sash stops when these stops are not necessary and the design of the hood provides the necessary minimum ventilation.

The requirements in subsection (e)(3) are changed by replacing the current requirement for a qualitative airflow indicator to a requirement for a quantitative indicator. The purpose of this change is to provide warning to the hood's operator that the airflow has changed, and may be reduced to a level insufficient to contain and capture air contaminants and prevent harmful exposure. Members of the advisory committee indicated that the current requirement for a means to continuously indicate that air is flowing into the exhaust system does not cover one of the most frequent safety problems found during routine hood surveys. The problem cited is a reduced flow without a total lack of flow. Belt slippage between the motor and blower was described as a common cause of this reduction. Duct blockage from chem wipes was also mentioned as a cause. Members of the committee noted that in the absence of a flow gauge the unsafe condition could continue for up to one year before it was discovered in an annual survey. A requirement that the quantitative flow indicator have an accuracy of $\pm 20\%$ is added to allow the use of a wide range of relatively low precision devices with accuracies near 10%. The 20% specification permits this wide range of devices to be used, while providing the user sufficient information regarding the operational state of the hood.

The requirement for inward airflow demonstration in subsection (e)(3) is also changed to reference a specific procedure for airflow demonstration and velocity measurement and that this demonstration is required to be conducted on an annual basis, as well as at installation, repairs or renovation, and the addition of large equipment into the hood. The change includes an exception permitting biannual airflow demonstration and airflow measurement if a calibration and maintenance program is in place for the quantitative indicator. This change was recommended by the advisory committee as a more definite method to demonstrate the capture and containment characteristics. The procedure specified includes both a small local smoke challenge to demonstrate capture and a gross challenge to demonstrate containment. The committee also recommended that if a calibration and maintenance program were in place that the frequency of smoke demonstration and velocity measurements could be reduced from annually to biannually.

The requirement at subsection (e)(7) specifying construction materials is changed to include references to more recent polymer materials which are suitable for construction of laboratory-hoods that are used in perchloric acid evaporation processes. This change was recommended by the advisory committee and is not intended to substantively alter the current requirement. This change is intended to reduce uncertainty when these more recent materials are used.

The advisory committee recommended adding a new subsection (f) regarding hood operator qualifications. The subsection is necessary to require that employers take steps to insure that employees understand the functional characteristics of the hood and are able to use the hood safely. The subsection is also necessary to require that the employees be familiar with the performance testing requirements for the hood and can determine when the hood was last tested.

DOCUMENTS RELIED UPON

1. Containment Testing for Occupied and Unoccupied Laboratory Chemical Hoods, Pamela L. Greenley, Louis J. DiBerardinis, Fredrick A. Lorch, P.E., ASHRAE Transactions: Symposia; CH-99-9-1, pages 733 to 737.

2. The Effect of Room Air Challenge on the Efficiency of Laboratory Fume Hoods (RP-70), Knowlton J. Caplan, P.E., Gerhard W. Knutson, Ph.D., ASHRAE Transactions 1977, Volume 83, Part 1, pages 11 to 22.
3. Petition to the Occupational Safety and Health Standards Board by Mr. Richard Yardley of George Yardley Company, dated May 27, 1997; Petition File No. 377.
4. The Occupational Safety and Health Standards Board's Petition Decision dated September 25, 1997 for Petition File No. 377.
5. Petition to the Occupational Safety and Health Standards Board by Mr. George A. Orff of DMG Corporation, dated January 14, 1999; Petition File No. 395.
6. The Occupational Safety and Health Standards Board's Petition Decision dated May 20, 1999 for Petition File No. 395.

These documents are available for review Monday through Friday from 8:00 a.m. to 4:30 p.m. at the Standards Board Office located at 2520 Venture Oaks Way, Suite 350, Sacramento, California.

DOCUMENTS INCORPORATED BY REFERENCE

- Section 6, Flow Visualization and Velocity Procedure, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., ANSI/ASHRAE 110-1995, Method of Testing Performance of Laboratory Fume Hoods.
- Section 7, Tracer Gas Test Procedure, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., ANSI/ASHRAE 110-1995, Method of Testing Performance of Laboratory Fume Hoods.

These documents are too cumbersome or impractical to publish in Title 8. Therefore, it is proposed to incorporate the documents by reference. Copies of these documents are available for review Monday through Friday from 8:00 a.m. to 4:30 p.m. at the Standards Board Office located at 2520 Venture Oaks Way, Suite 350, Sacramento, California.

REASONABLE ALTERNATIVES THAT WOULD LESSEN ADVERSE ECONOMIC IMPACT ON SMALL BUSINESSES

No reasonable alternatives were identified by the Board and no reasonable alternatives identified by the Board or otherwise brought to its attention would lessen the impact on small businesses.

SPECIFIC TECHNOLOGY OR EQUIPMENT

This proposal will not mandate the use of specific technologies or equipment.

COST ESTIMATES OF PROPOSED ACTION

Costs or Savings to State Agencies

No significant costs or savings to state agencies will result as a consequence of the proposed action. The change proposed to subsection (e)(3) will require the installation of a quantitative airflow indicator on those hoods without such indicators. A representative of a major laboratory hood manufacturer attended several advisory committee meetings and estimated that the majority of hoods installed in the last 5 to 7 years had installed flow indicators. He also estimated that approximately 50% of hoods older than this had installed indicators. The cost for the indicator is the sum of the components' cost and labor cost for installation. Simple diaphragm gages, inclined manometers, and vane indicators with installation kits range from \$22 to \$70. Labor costs are estimated to range from \$50 to \$100 per hour and installation time one to three hours. The estimated one time costs for this indicator is therefore between \$72 and \$370. Subsection (e)(3) is also changed to require a specific procedure for airflow demonstration and velocity measurement and this demonstration is required to be conducted on an annual basis, as well as at installation, repairs or renovation, and the addition of large equipment into the hood. The change includes a "note" permitting biannual airflow demonstration and airflow measurement if a calibration and maintenance program is in place for the quantitative indicator. The change will require both small and gross smoke challenges on an annual or biannual basis. The cost associated with this is the sum of the costs of the smoke generating equipment and labor for performing the test. The equipment costs are estimated at approximately \$7 and the labor between \$50 and \$100 for the test. The cost estimate is therefore between \$57 and \$107.

Impact on Housing Costs

The Board has made an initial determination that this proposal will not significantly affect housing costs.

Impact on Businesses

The Board has made an initial determination that this proposal will not result in a significant, statewide adverse economic impact directly affecting businesses, including the ability of California businesses to compete with businesses in other states.

Cost Impact on Private Persons or Businesses

The Board is not aware of any significant cost impacts that a representative private person or business would necessarily incur in reasonable compliance with the proposed action. The change proposed to subsection (e)(3) will require the installation of a quantitative airflow indicator on those hoods without such indicators. A representative of a major laboratory hood manufacturer attended several advisory committee meetings and estimated that the majority of hoods installed in the last 5 to 7 years had installed flow indicators. He also estimated that approximately 50% of hoods older than this had installed indicators. The cost for the indicator is the sum of the components' cost and labor cost for installation. Simple diaphragm gages, inclined manometers,

and vane indicators with installation kits range from \$22 to \$70. Labor costs are estimated to range from \$50 to \$100 per hour and installation time one to three hours. The estimated one time costs for this indicator is therefore between \$72 and \$370. Subsection (e)(3) is also changed to require a specific procedure for airflow demonstration and velocity measurement and this demonstration is required to be conducted on an annual basis, as well as at installation, repairs or renovation, and the addition of large equipment into the hood. The change includes an exception permitting biannual airflow demonstration and airflow measurement if a calibration and maintenance program is in place for the quantitative indicator. The change will require both small and gross smoke challenges on an annual or biannual basis. The cost associated with this is the sum of the costs of the smoke generating equipment and labor for performing the test. The equipment costs are estimated at approximately \$7 and the labor between \$50 and \$100 for the test. The cost estimate is therefore between \$57 and \$107.

Costs or Savings in Federal Funding to the State

The proposal will not result in costs or savings in federal funding to the state.

Costs or Savings to Local Agencies or School Districts Required to be Reimbursed

No costs to local agencies or school districts are required to be reimbursed. See explanation under “Determination of Mandate.”

Other Nondiscretionary Costs or Savings Imposed on Local Agencies

This proposal does not impose a significant nondiscretionary costs or savings on local agencies.

DETERMINATION OF MANDATE

The Occupational Safety and Health Standards Board has determined that the proposed regulation does not impose a local mandate. Therefore, reimbursement by the state is not required pursuant to Part 7 (commencing with Section 17500) of Division 4 of the Government Code because this regulation does not constitute a “new program or higher level of service of an existing program within the meaning of Section 6 of Article XIII B of the California Constitution.”

The California Supreme Court has established that a “program” within the meaning of Section 6 of Article XIII B of the California Constitution is one which carries out the governmental function of providing services to the public, or which, to implement a state policy, imposes unique requirements on local governments and does not apply generally to all residents and entities in the state. (County of Los Angeles v. State of California (1987) 43 Cal.3d 46.)

The proposed regulation does not require local agencies to carry out the governmental function of providing services to the public. Rather, the regulation requires local agencies to take certain steps to ensure the safety and health of their own employees only. Moreover, the proposed regulation does not in any way require local agencies to administer the California Occupational

Safety and Health program. (See City of Anaheim v. State of California (1987) 189 Cal.App.3d 1478.)

The proposed regulation does not impose unique requirements on local governments. All employers - state, local and private - will be required to comply with the prescribed standard.

EFFECT ON SMALL BUSINESSES

The Board has determined that the proposed amendments may affect small businesses.

ASSESSMENT

The adoption of the proposed amendments to this regulation will neither create nor eliminate jobs in the State of California nor result in the elimination of existing businesses or create or expand businesses in the State of California.

ALTERNATIVES THAT WOULD AFFECT PRIVATE PERSONS

No reasonable alternatives have been identified by the Board or have otherwise been identified and brought to its attention that would be more effective in carrying out the purpose for which the action is proposed or would be as effective and less burdensome to affected private persons than the proposed action.